COMPARISON OF DOUGLAS FIR-HEMLOCK AND OAK-HICKORY BIOTIC COMMUNITIES

BY
JANE CLAIRE DIRKS
B.A., Linfield College, 1937

AN ABSTRACT OF A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
ZOOLOGY IN THE GRADUATE SCHOOL OF THE
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Numerous specialists have made identifications of the various groups of organisms in the two communities. The author is very grateful to all of them for their invaluable assistance.

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COMPARISON OF DOUGLAS FIR-HEMLOCK AND OAK-HICKORY BIOTIC COMMUNITIES

A study of biotic communities in the Moist Coniferous Forest and Eastern Deciduous Forest Biomes forms the basis for this comparison. The climax oak-hickory woods near White Heath in Piatt County, Illinois, is a part of the Oak-Hickory Association. This association is the westernmost one of the Eastern Deciduous Forest Biome and originally extended from Wisconsin southward into Oklahoma. Field observations and collections were made in the oak-hickory community at weekly, bi-weekly, or monthly intervals from October 24, 1937, to April 2, 1940. The Douglas fir-hemlock forest on Saddle Mountain in northeastern Lincoln County, Oregon, (1400 feet altitude) is a late subclimax associes of the Cedar-Hemlock Association in the Moist Coniferous Forest Biome. The biome extends along the Pacific coast from northern California to southern Alaska. The study station was visited once in the latter half of June, July, and August every year from 1935 to 1938, inclusive. Census methods employed in the two communities were essentially similar and included vertebrate and invertebrate animals as well as plants.

Climate. From 1934 to 1937, inclusive, the average annual precipitation in the Douglas fir-hemlock community was 89.28 inches, varying from 0.58 (August) to over 14.38 inches (December); the annual mean relative humidity was 81.1%; and the monthly mean temperature varied from 36.4 to 62.3°F. with an annual mean of 49.5°. In the oak-hickory community during the same period the average annual precipitation was 36.29 inches, ranging from 1.58 (February) to 5.53 inches (September); the annual mean relative humidity was 70.2%; and the monthly mean temperature ranged from 26.6 to 79.0°F. with an annual mean of 52.1°.

Ecological equivalents. The plants and animals in the two communities constitute ecologically equivalent groups. The list which follows indicates the more important taxonomic differences.

	Douglas fir-hemlock community	Oak-hickory community
A. Dominants (Trees)	*Pseudotsuga taxifolia* Britt.	*Quercus alba* L.
	Tsuga heterophylla Sarg.	*Quercus borealis maxima* Ashe
	Thuja plicata D. Don.*	*Carya* spp.
	Abies spp.	*Ulmus americana* L.
B. Subdominants		
(Shrubs)	Deciduous	Deciduous
	Vaccinium ovalifolium Smith	*Sambucus canadensis* L.
	Vaccinium parvifolium Smith	*Euonymus atropurpureus* Jacq.
	Evergreen	*Symphoricarpos orbiculatus* Moench
	Berberis nervosa Pursh.	*Crataegus* spp.
	Gaultheria shallon Pursh.	*Viburnum* sp.
	Polystichum munitum (Kaulf.) Presl.	*Podophyllum peltatum* L.
(Herbs)	*Achlys triphylla* (Smith) D. C.	*Impatiens biflora* Walt.
	Oxalis oregona Nutt.	*Eupatorium urticaefolium* Reichard
	Juncoides parviflorum (Ehrl.) Coville	*Arisaema triphyllum* (L.) Schött.
	Clintonia uniflora (Schult.) Kunth.	
C. Major Influents	Present	Extirpated
	Euarctos americanus altifrontalis (Elliot)	*Euarctos a. americanus* (Pallas)
	Felis concolor oregonensis Rafinesque	*Felis couguar* Kerr
	Lynx rufus fasciatus Rafinesque	*Lynx r. rufus* (Schreber)
	Odocoileus c. columbianus (Richardson)	*Odocoileus v. virginianus* (Boddaert)
		Present
	Lepus americanus washingtonii Baird	*Sylvilagus floridanus mearnsii* (Allen)
	Martes c. caurina (Merriam)	*Mustela frenata noveboracensis* (Emmons)
	Buteo borealis (Gmelin)	*Buteo lineatus* (Gmelin)
	Otus asio brewsteri Ridgway	*Otus asio naevius* (Gmelin)
D. Minor Influents		
	Peromyscus maniculatus rubidus Osgood	*Peromyscus leucopus noveboracensis* (Fischer)
	Microtus o. oregoni (Bachman)	*Pitymys pinetorum scalopsoides* (Audubon & Bachman)
	Clethrionomys c. californicus (Merriam)	
	Scapanus o. orarius True	*Blarina brevicauda* (Say)

	Sorex t. trowbridgii Baird	*Cryptotis parva* (Say)
	Penthestes rufescens (Townsend)	*Penthestes atricapillus* (Linnaeus)
	Cyanocitta stelleri (Gmelin)	*Cyanocitta cristata* (Linnaeus)
	Hylocichla ustulata (Nuttall)	*Hylocichla mustelina* (Gmelin)
E. Subinfluents		
(Gastropoda)	*Ariolimax columbianus* (Gould)	*Philomycus carolinianus* (Bosc)
	Haplotrema vancouverense (Lea)	*Haplotrema concavum* (Say)
(Myriapoda)	*Oabius aiolus* Chamberlin	*Poaphilus kewinus* Chamberlin
(Araneida)	*Hexura picea* Simon	*Origanates rostratus* (Emerton)
	Theridion sexpunctatum Emerton	*Micrathena gracilis* (Walckenaer)
(Neuroptera)	*Hemerobius pacificus* Banks	*Chrysopa plorabunda* Fitch
(Coleoptera)	*Scaphinotus angusticollis* (Fischer)	*Amara impuncticollis* Say
	Timarcha intricata Hald.	*Metriona bicolor* (F.)
	Sciopithes obscurus Horn.	*Apion griseum* Smith

* Characteristic, though not present in area studied intensively.

Reactions affecting soil complex. A comparison of soil producing reactions of plants and animals shows that the soil of the oak-hickory community is the richer in organic material. Birds with scratching and mixing reactions are nearly twice as abundant in the oak-hickory woods, and invertebrates, also, are approximately twice as numerous there; consequently, the soil of the oak-hickory woods is mixed more thoroughly than the soil of the Douglas fir-hemlock community. In soil making and mixing reactions, earthworms (Lumbricidae), Myriapoda, Collembola, mites, and moles in the Douglas fir-hemlock community have their equivalents in ants, Myriapoda, Collembola, mites, pine mice, and short-tailed shrews in the oak-hickory community.

Reactions modifying aerial factors. These are at least slightly more pronounced in the Douglas fir-hemlock community than in the oak-hickory community. In the summer the reduction of light intensity in the two communities appears to be similar though data are incomplete. In the winter, however, the oak-hickory community is exposed to nearly full light intensity while the light in the Douglas fir-hemlock forest is decreased still more through the high proportion of cloudy

days. Thermal blanketing by the vegetation is more pronounced in the coniferous forest especially during the winter seasons.

Shelter coactions. During the summer seasons more bird species and individuals nest in the canopy and in cavities in the deciduous trees than in the coniferous. However, only about one-half of the birds in the oak-hickory community are permanent residents while all but about one-seventh of the Douglas fir-hemlock species are permanent residents. More mammals find shelter under fallen logs, branches, and brushy accumulations on the forest floor of the coniferous forest since much more of this kind of shelter is present in that community. Several of the large mammals which have been extirpated from the oak-hickory community used shelter of this kind.

Food coactions. During the summer months the total insect population, as determined by quantitative collections from the shrub, herb, and ground layers, is approximately twice as large in the oak-hickory community as it is in the Douglas fir-hemlock community. Correlated with this is the fact that the insectivorous birds are much more numerous and varied in specific composition in the oak-hickory woods than they are in the coniferous.

Aphids are the chief invertebrates which suck the juices from plants in the Douglas fir-hemlock community, while in the oak-hickory community they share this coaction with numerous leafhoppers, fulgorids, and Hemiptera. In the coniferous forest there is a close correlation between abundance of aphids and spiders; as the spiders increase in numbers during the summer, the abundance of aphids decreases rapidly; spiders are much more numerous in this community than they are in the deciduous woods.

There are few species and individuals of leaf eating beetles and Lepidoptera in the Douglas fir-hemlock community; these are numerous in the oak-hickory woods. Their abundance undoubtedly is correlated with the abundance of their food.

In the Douglas fir-hemlock community pine siskins and crossbills feed almost exclusively on conifer seeds. Six addi-

tional bird species are present which feed upon seeds and fruits to some extent; ten species with these food habits occur in the oak-hickory community. Two carnivorous species of birds are common in the deciduous community while six are present in the coniferous forest.

The small mammals in the two communities are approximately equivalent in food habits.

Population comparisons. In the summer seasons the oak-hickory community supports a more varied and abundant invertebrate population (based on quantitative collections) than the Douglas fir-hemlock community.

	Douglas fir-hemlock	Oak-hickory
Insects (other than Apterygota), No. per M_2	465	822
Total invertebrates, No. per M_2	963	1573

The percentage of individuals in the various groups constituting the invertebrate population also differs.

	Douglas fir-hemlock	Oak-hickory
Arachnida	31%	8%
Myriapoda	8	1
Apterygota	22	22
Homoptera	10	7
Hemiptera	Less than 1	3
Coleoptera	5	10
Diptera	9	7
Hymenoptera	(no ants) 4	24 (many ants)
Enchytraeidae	5	16
All others	5+	2

Aspection. In the oak-hickory community the seasons are sharply defined by both plant and animal activities. Only the summer seasons have been studied in detail for the Douglas fir-hemlock forest, but aspection appears to be less clearly defined there. Insects hibernate in the oak-hickory community in response to falling temperature and decreasing leaf shelter on the plants. This phenomenon, so far as observed, is largely lacking in the Douglas fir-hemlock community. The presence of northward migrating birds in the oak-hickory com-

munity is closely correlated with abundance of the kinds of food taken by the various species.

The bird population of the oak-hickory community changes greatly with the weather conditions during the winter seasons. Birds leave the small exposed upland woods to find shelter in the nearby floodplain community. This is probably a local phenomenon conditioned by the smallness of the woods and the proximity of the floodplain community.

Annuation. The invertebrate population in the oak-hickory community averaged higher in 1938-39 than in 1937-38. This larger population may have been due partially to the milder winter preceding it.

A much larger group of robins was present in the oak-hickory woods during the northward migration in the spring of 1939 than the preceding year. In 1939 a sharp drop in the invertebrate population during the vernal season followed the visit of the robins.

VITA

Jane Claire Dirks was born near Haney, Arkansas, June 9, 1912. The first six years of her elementary education were secured in the public schools of the state of Kansas. The last two years were completed in Washington and Oregon, respectively.

In 1926 Miss Dirks entered high school at Roseburg, Oregon, and was graduated there in 1930 as the salutatorian of her class. For the next two years she was employed as stenographer and teller in the Douglas National Bank of Roseburg.

In the fall of 1932 she resumed her education by matriculating in Linfield College, McMinnville, Oregon. There she secured her Bachelor of Arts degree "magna cum laude" in 1937 with a major in biology. She held an assistantship in the department of biology during her last three years at Linfield.

Miss Dirks began her graduate career at the University of Illinois in the fall of 1937. She held a graduate assistantship in the department of zoology during the academic years 1937 to 1941 and the summer session of 1939. In the summer of 1938 she made an investigation on the marine plankton along the northern part of the Oregon coast.

Societies of which she is a member include Sigma Xi, Phi Sigma, Pi Gamma Mu, A. A. A. S., Ecological Society of America, and the Illinois Academy of Science.

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